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THE BAKER VALVE GEAR

(BAKER-PILLIOD)

Supplement to

The Science of Railways

BY

Marshall M. Kirkman

CHICAGO

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1912

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The Baker Valve Gear

The Baker Valve Gear, which is an improvement over what was known as the Baker-Pilliod Valve Gear, is an outside radial gear, i. e., it has no links or sliding blocks. The movement is derived from the crosshead and the eccentric crank. The crosshead moves the valve the amount of the lap and lead each way, and the eccentric crank gives the remainder of the movement. In the short cut-offs the actual effect of the eccentric crank is reduced, while the crosshead movement is constant.

The bearings are all pins and bushings, the latter being ground inside and out to a standard gauge. The pins are case-hardened and ground to size on both the bearing and tapers.

The improved gear has ten per engine less bearings than the old one and the movement of nearly all has been greatly reduced. Three bearings or joints on each side of the engine, aside from the reach-rod, move when the reverse lever is changed.

No loose oil cups are employed; each bearing has an oil reservoir or cup which is made integral with the part. These cavities can be filled with waste or curled hair to retain the oil, obviating the danger of a bearing running dry on the longest runs. All these bearing pins and bolts are exposed to view so that they can be got at

to be removed by the engineman or repairman. Three pins, or two pins and a bolt, remove the hardest piece to be taken down. The heaviest piece, the bell crank, weighs only 86 pounds.

Standardization of Parts—This has been reached to some extent in the Baker Gear as all the outside admission gears of this make are alike and all the inside gears are the same, no matter what the type or class of engine upon which used. The yokes and radius bars are also the same for both admissions. The combination lever must suit the stroke of the engine and the lap and lead. Since there is not enough difference in the power it takes to operate a valve on the different modern engines it does not warrant different sized gears. With other gears there is not much, if any, difference in the cross-section area of the same part on the different engines. All parts are interchangeable, and the castings, including the frame, are the same for both sides of the engine except the gear connection rod. The combination lever has rights and lefts, but they are drop-forged.

The frame is one piece cast steel, the same casting on both sides of the engine; one type for inside admission and another type for outside admission. The frame is designed with an extension so that the same frame will go on a variety of engines. This reduces to the minimum the number of kinds of frames that any road may have. So far two designs of outside and one design of inside admission frame have been used. Fig. 1 shows a general view of the gear.

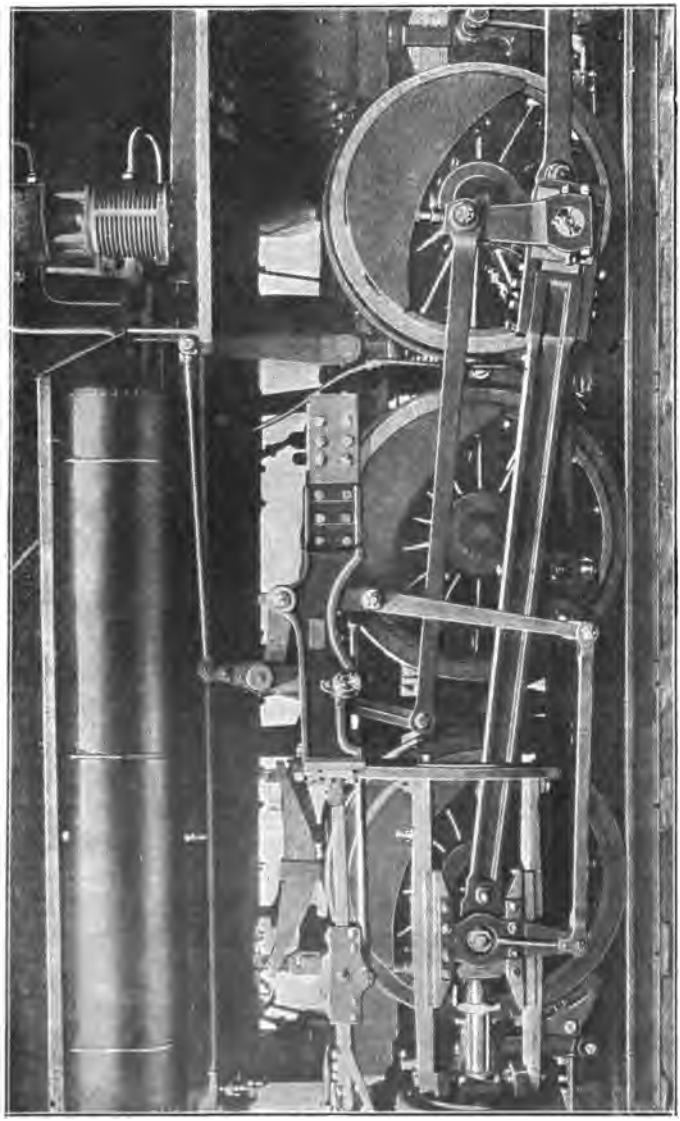


Fig. 1

Alignment—Every part of the gear is symmetrical with respect to the center line of the gear, and all pins are supported on each end. This makes a straight line motion, and prevents the possibility of a twisting effect on any part. This construction is claimed to increase the strength of the gear and also the wearing quality of the bearings.

Lead and Preadmission—The Baker Gear has a constant lead with a variable preadmission. The objections to a constant lead have been that it retarded the engine while running in full gear and did not give compression enough in the short cut-offs.

It makes no difference what lead there is in full gear so long as there is not preadmission which is the factor in compression. In full cut-off the Baker Gear has practically no preadmission and the indicator cards show a low compression line. This means a "quick" engine.

As the cut-off is shortened, the preadmission increases, and at 25 per cent there is from ¾-inch to ⅞-inch preadmission.

Fig. 2 shows in a general way the action of the Baker Gear for outside admission. On an inside admission gear the bell crank stands ahead of the reverse yoke and point L for the connection of the valve rod is below point K instead of above. The eccentric crank follows in both cases.

The circle AD is the path of the crank pin. Circle BB′ is the eccentric crank circle. ADX is

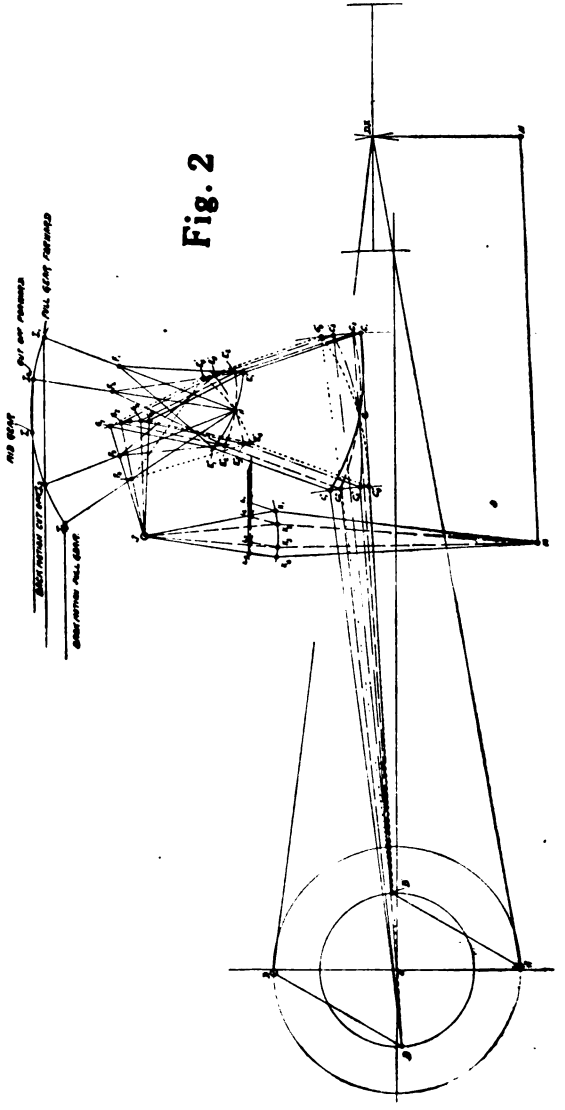


Fig. 2

the main rod. DX is the crosshead. DXN is the crosshead arm. MN is the union link. MKL the combination lever. KJG the bell crank. The gear connection rod is GEC. EF shows the radius bar. HI is the reversing yoke.

The two movements of the gear are as follows: One from the eccentric crank B which follows the main pin at about 90 degrees. The other motion from the crosshead through the combination lever. The eccentric crank moves the radius bar and the action the radius bar has on the valve is controlled by the reverse yoke. The radius bar and yoke take the place of the link and block of a link motion. The combination lever throws the valve the amount of the lap and lead, the same as in the Walschaerts Gear. This makes the lead constant and independent of the cut-off. Having a constant lead the valve should show lead opening in all cut-offs when the engine is on either dead center.

The cut-off, release and compression is done by means of the eccentric crank and controlled by the reversing yoke. The yoke controls the length of the cut-off and also reverses the engine. The action is as follows: Eccentric crank in going from B′ to B moves point C from C'_{-1} to C''_{-1}. By this movement it moves pin E'_{-1} through H to E''_{-1}. The particular path of E is an arc whose radius is $E'_{-1}F_{-1}$. Thus it will be seen that EF causes point E to raise. This rising movement moves G from G_{-4} to G_{-1} which, by means of the bell crank, moves K from K_{-4} to K_{-1}. This it can be seen will move the

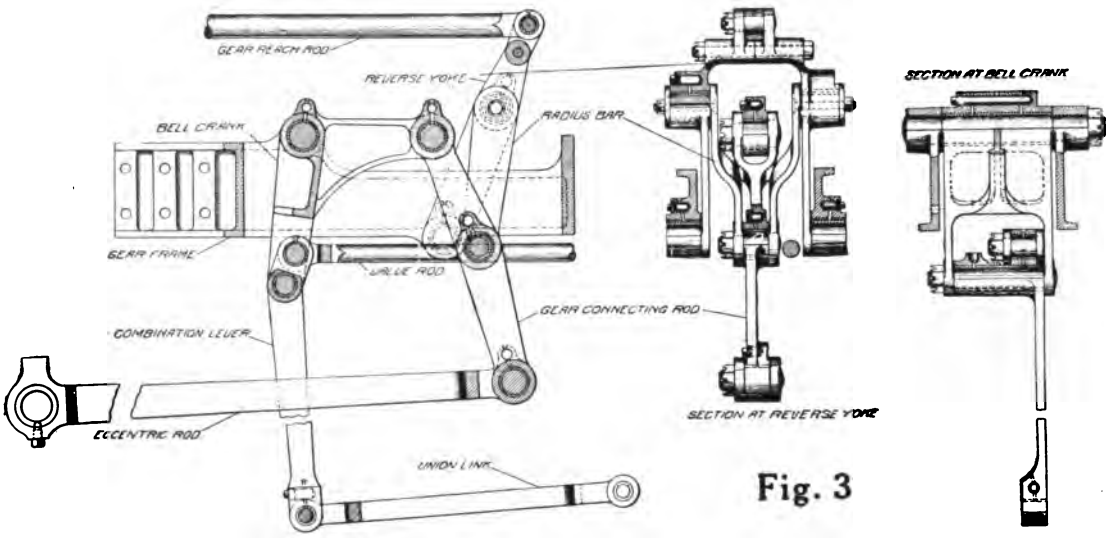


Fig. 3

LONGITUDINAL SECTION

OUTSIDE ADMISSION

valve forward. The valve is moved backward to its original position in the next half turn of the wheel. The peculiar action of the combination lever is not shown. As the combination lever does its important work near the dead center of the engine and when the engine is in the position as shown in the diagram the combination lever is as shown on the diagram.

From the diagram it will be noticed that E has a rising and falling movement caused by the radius bar EF. If the yoke is changed from I_1 to I_{-2} it would change the center of the radius F. So that E will move from E'_{-2} to E''_{-2} in other words, the rising and falling movement is cut down which would move G from G_{-3} to G_{-2} and K from K_{-3} to K_{-2}. Thus it will be seen that with the varying position of the yoke I the amount of movement of the valve varies. When I is in the mid-gear position E would not move up and down at all but simply swing back and forth in an arc. If I is put in full backward motion the same motion of the eccentric crank that caused the rising movement before would cause the falling movement in the back motion and E would go from E''_{-4} to E'_{-4}. The full motion backward is shown by a dotted line and the short cut-off in backward motion by dash and three dots.

Instructions on Setting the Baker Gear—Connect up the whole gear. An adjustable union link and eccentric rod are convenient but not strictly necessary.

With reverse lever in mid-gear, adjust the long

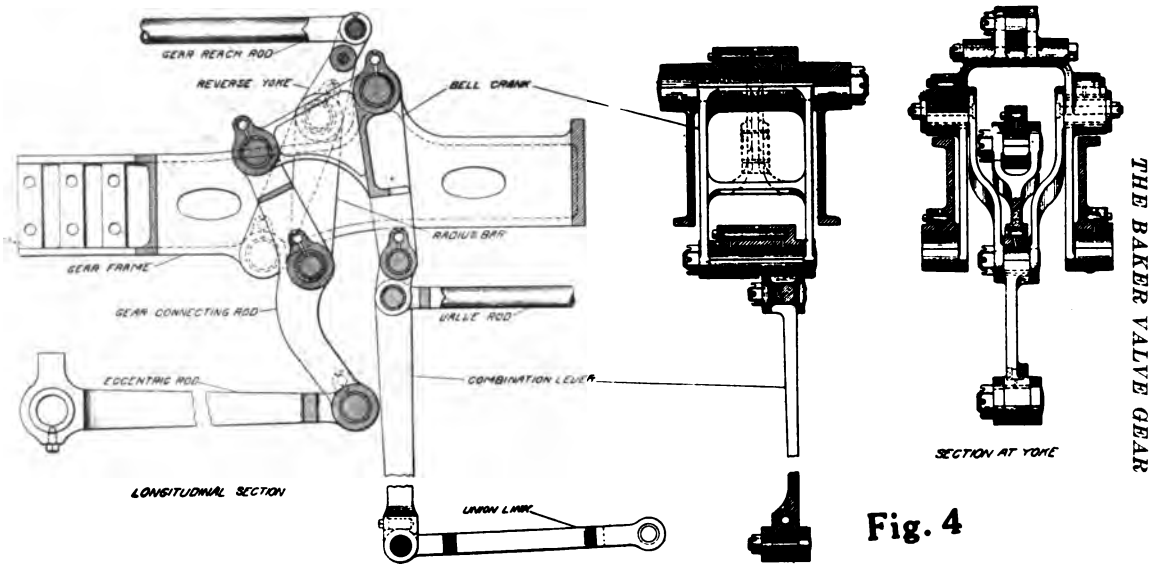
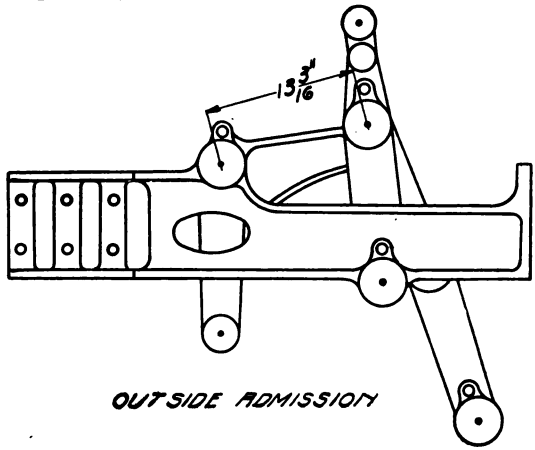


Fig. 4

INSIDE ADMISSION

reach rod until the reverse shaft arms are about plumb. Adjust the short reach rods so that the yoke stands as shown in Fig. 5. After gear is all set, square up the travel on the two sides of the engine by adjusting the short reach rods.



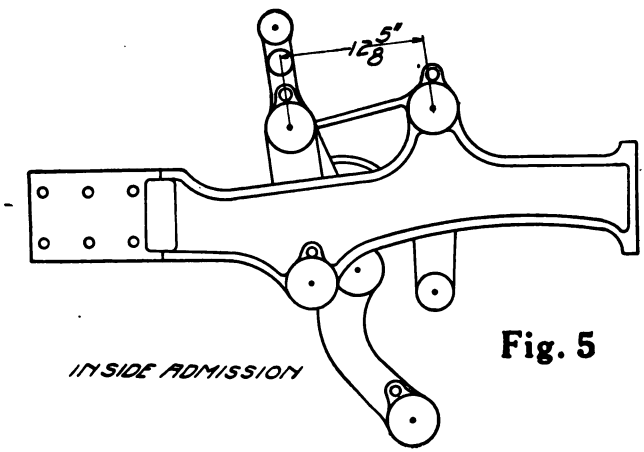


Fig. 5

The dead centers are located in the usual way.

Eccentric Crank and Rod—Point "B," Fig. 6, should come to the same place with engine on either dead center. Put engine on front dead center. Throw reverse lever full sweep of quadrant. The valve should be dead. If the valve moves it is the fault of the eccentric crank or eccentric rod. Advance the dead center and try for a dead valve again. If valve moves less than it did, keep on advancing the center until valve is dead. If when the center is advanced the movement of the valve increases, the main wheel was moved the wrong way. In this case retard the center until the valve is dead.

When valve is dead "B," is properly located. Transfer "B" by means of a tram to some stationary point as the guide or guide yoke marked "A." From "A" scribe the pin at "B." (This scribe line will pass through the center of pin.)

Put engine on front dead center and scribe pin at "B" again, then with engine on back dead center scribe pin "B" again. If eccentric rod and crank are both correct these two lines will cross in the center of pin "B" (See Fig. 7), if they do not Figs. 8, 9, 10, 11, 12, 13 and 14 will explain what is the matter and how to correct it. Be sure that the eccentric crank throw is called for on the drawings. If the eccentric crank is not over ⅛-inch from correct, change crank throw until tram marks show correct. If crank is short shift pin as per arrow "C," (Fig. 6), if long, shift as per arrow "D."

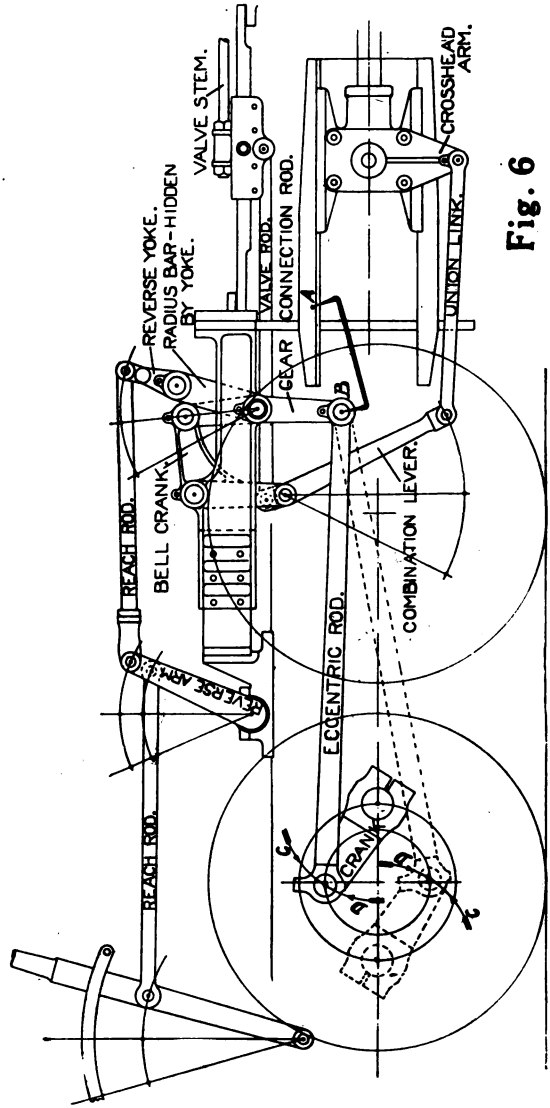
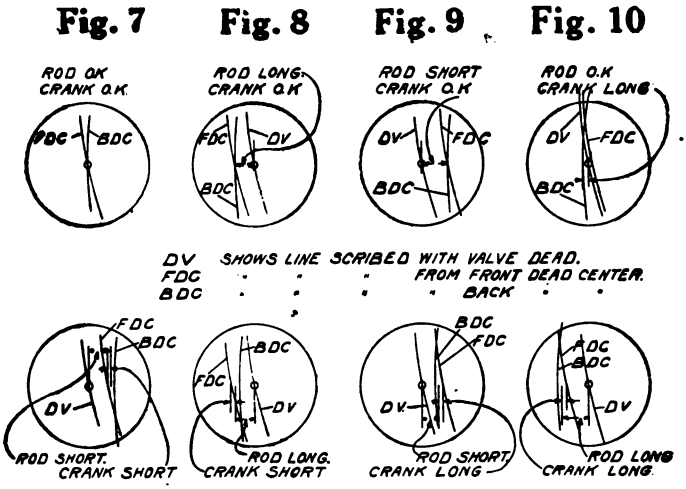

VALVE STEM.
CROSSHEAD ARM.
REVERSE YOKE.
RADIUS BAR-HIDDEN BY YOKE.
VALVE ROD.
CONNECTION ROD.
UNION LINK.
GEAR
REACH ROD.
BELL CRANK.
COMBINATION LEVER.
ECCENTRIC ROD.
REACH ROD.
CRANK

Fig. 6



Union Link—With crosshead midway between striking points, plumb the combination lever and adjust union link to suit. If length is within ½-inch of correct, it will not pay to make the change.

Adjust the valve stem until lead is square on both dead centers.

Squaring Travel—The short reach rods act the same as a link hanger on the Stephenson Gear. Adjust the length so that both sides of the engine have the same valve travel. One turn on a reach rod having ten threads takes ⅛-inch travel off one motion and adds to the other.

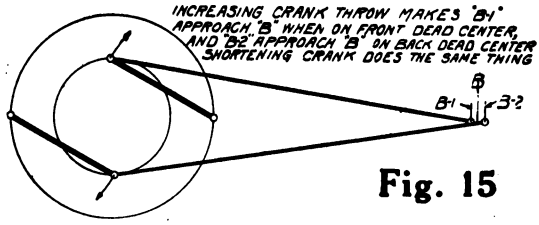


Fig. 15

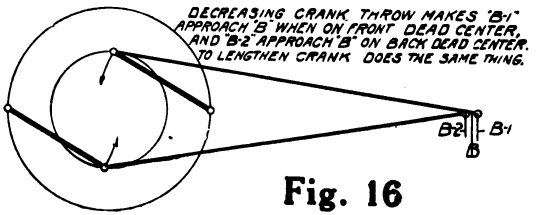


Fig. 16

Cut-off and Eccentric Rod—If the eccentric rod is off in length you can tell it by the following rule: If cut-offs are long on front end in forward motion and long on the back end in backward motion, the rod is too long. If the cut-offs come just the opposite of the foregoing then the rod is too short.

Break Downs—Two means are provided for blocking the gear and valve in case of a break down. The valve stem crosshead is provided with a set-screw so that the valve can be blocked central over the ports by clamping the valve stem crosshead to its guide. This is done in case the breakage on the gear or engine disables one side. (See Fig. 19.)

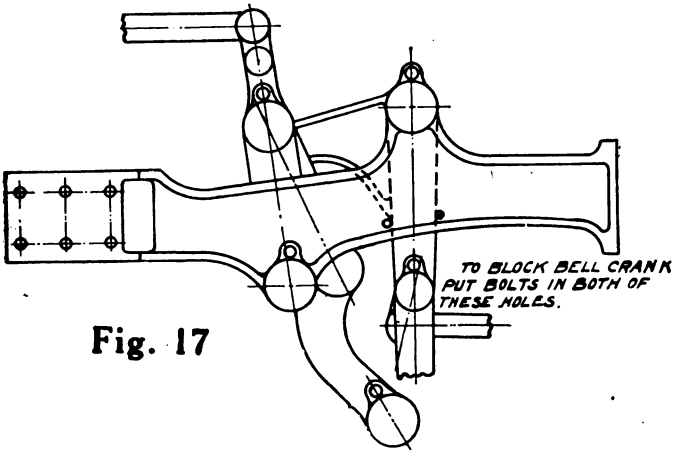


Fig. 17

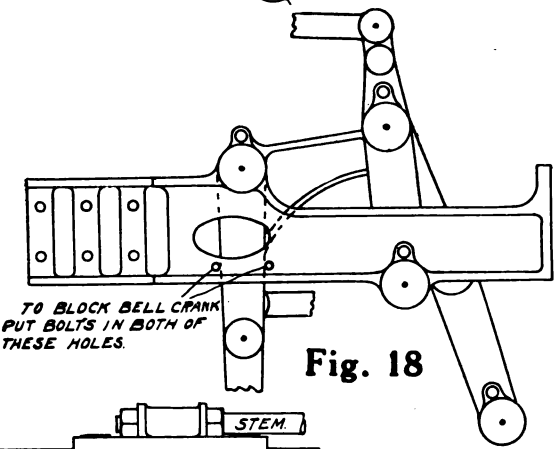


Fig. 18

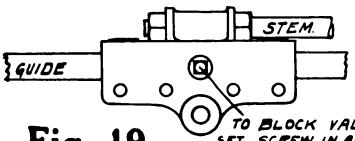


Fig. 19